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<b>(54) Title:</b> QUICK-DRYING NAIL ENAMEL COMPOSITIONS  <b>(57) Abstract</b>  <p>The present invention relates to novel, quick drying nail enamel compositions which dry in a period of time no greater than about three minutes. The compositions of the present invention preferably dry in a period no greater than about two minutes and most preferably dry in a period no greater than about 90 seconds. Compositions drying in a period less than 60 seconds are especially preferred and are also described. The compositions of the present invention which contain sufficient quantities of organoclay thixotropic agents have acceptable stitic viscosities ranging from about 400 to about 1200 centipoises and may accommodate numerous pigments to produce nail enamel compositions exhibiting favorable characteristics, including acceptable durability and gloss. Methods of coating natural or synthetic nails are also disclosed.</p>		

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## QUICK-DRYING NAIL ENAMEL COMPOSITIONS

Field of the Invention

The present invention relates to novel, quick drying nail enamel compositions which dry in less than about three minutes. The compositions of the present invention preferably dry in a period of time no greater than about two minutes and more preferably dry in a period no greater than about 90 seconds. Compositions drying in a period less than 60 seconds are especially preferred and are also described. The compositions of the present invention have acceptable static viscosities ranging from about 400 to about 1200 centipoises and may accommodate numerous pigments to produce nail enamel compositions exhibiting favorable wear characteristics, including acceptable durability and gloss.

The compositions of the present invention comprise a primary film-forming polymer, a secondary film-forming polymer, for example, a resin which functions to strengthen the primary film-forming polymer and improve the adhesion and gloss of the nail enamel, a plasticizer, a thixotropic agent, preferably an organoclay thixotropic agent and a solvent system containing acetone in an amount no less than about 4.5% and preferably no less than about 13% by weight of the composition and at least one additional solvent and preferably including a wetting solvent and a diluent solvent. In preferred compositions according to the present invention, acetone comprises about 15% to about 25% of the total weight of the composition. In a particularly preferred embodiment, the nail enamel compositions according to the present invention contain about 18% to about 22% by weight acetone. Preferably, the nail enamel compositions of the present invention also contain a pigment for coloring the nail coating, in addition to other additives such as preservatives, stabilizers and fragrances. Other nail enamel compositions which do not contain a thixotropic agent or pigment are also disclosed by the present invention.

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Background of the Invention

A large number of methods and compositions for beautifying and strengthening the nails of humans are well known. Prior art methods include coating the nail of an animal, including humans with a composition including a film-forming polymer and additional ingredients such as pigment, plasticizer and solvents or alternatively, attaching preformed artificial nails to human nails with adhesives. Additional methods include adding crosslinkable polymers to nail coating compositions to mend, strengthen and elongate natural nails and repairing nails with a fabric patch.

Most nail enamel compositions presently on the market or disclosed in the prior art dry in five minutes or longer. Even those nail enamels that claim to be quick-dry, i.e., dry in about five minutes, are often not truly dry but rather are only dry to the touch. When a purportedly "dry" nail enamel of the prior art brushes up against a hard surface, the nail enamel often smudges, leaving tack.

One nail polish drying composition disclosed in United States Patent Number 4,798,720 prepared from commercially available top coat nail polish, acrylic nail powder, acrylic nail primer and the adhesive "crazy glue" is described as being used in combination with commercially available colored nail polishes to alter the drying time of the nail polish to a period of more than three minutes. The compositions of this patent are used as base coats in combination with commercially available pigment containing nail polishes. The patent claims to dry from one to seven coats of pigment containing nail polish within a period ranging from about three to five minutes. This composition functions as a base coat or top coat and unlike the composition of the present invention, must be used in combination with a commercially available pigment nail polish to provide a lasting pigmented nail enamel finish.

A nail polish which can be used to coat a natural or synthetic nail which dries in less than three minutes without

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requiring an additional application of a base coat or top coat as is disclosed in the prior art would be very desirable. Nail polishes which dry in a period of less than 150 seconds would be even more desirable, as would polishes that dry in periods less than about 90 seconds. A nail polish composition which would dry in a period of no greater than about 60 seconds would be especially useful in situations where "drying" time is important.

Working women need to have a product which can be easily applied and which dries in the shortest amount of time to avoid a situation where they are simply wasting precious time waiting for their nail polish to dry. In the manicure and pedicure industries, a pigmented nail polish composition which can dry in a period less than three minutes would provide a significant advantage over the prior art compositions.

Solvent mixtures for nail enamels of the prior art have covered a wide range of compositions and have included as many as six or seven solvents to control flow, viscosity, evaporation rate and drying time of the enamel. As discussed in Peirano, "Nail Lacquers and Removers", Cosmetics Science and Technology, Interscience Publishers, Inc., 1957, solvent or mixed solvents used as the volatile portion of nail enamels are of prime importance because of their direct effect on ease of application of enamel, on the rate of drying and hardening, on the viscosity of the enamels and on the characteristics of the final film. According to this reference, too rapid a rate of evaporation causes a poor flow of the enamel and also gives an uneven, streaky application. The reference also cites the importance of proper solvent balance during the drying stages of the lacquer. In general, due to the wide differences in evaporation rates of the solvents which are included in the prior art compositions, these compositions undergo many changes during the drying of the film. For example, during the course of evaporation of the solvent from the nail enamel on the nail, differential evaporation of the solvents within the composition may result in the presence of higher concentrations of certain solvents during drying, which in turn

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creates precipitation of the film forming polymer, resin and/or plasticizer, thereby destroying the integrity of the film and the appearance of the enamel. If the solvent becomes too lean to maintain the solubility of the resin in solution, the resin will precipitate, also resulting in unacceptable results.

Another reference which provides insight into the solvent mixtures useful in nail enamels and briefly touches the subject of drying time is an article by Harvey M. Remz, Cosmetics and Toiletries, Vol. 103, 70 (1988). In this reference, Mr. Remz points out that providing solvent balance is a complex task in formulating a nail enamel composition and briefly discusses evaporation rate and the volatility of solvents included in nail polish on page 76.

The complicated character of the nail enamel mixtures of the prior art and the many possible combinations of volatile and nonvolatile components had, until the unexpected discovery of the present invention, made the determination of a proper solvent balance from the perspective of viscosity, solubility of the individual components and the acceptability of the deposited enamel (gloss) in combination with a drying time of less than three minutes virtually impossible. Until the discovery of the present invention, the identification of the evaporation rates of the individual solvents under various conditions had not removed the uncertainty involved in determining a suitable solvent balance incorporating quick-drying characteristics. Although the desirability of a quick drying nail enamel has been a long-felt need, the rate of drying of the nail enamels of the prior art has been limited by the aforementioned considerations. Thus, before the discovery of the present invention, simply incorporating low boiling solvents did not increase the likelihood that an acceptable solvent system for nail enamels would be found or that one could obtain a nail enamel composition which dried in under three minutes. In the present invention, the use of acetone in certain weight percentages of the composition, in combination with numerous solvents which provide acceptable

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viscosity, creates a consistent quick-drying solvent system which provides the nail enamel with favorable characteristics of drying time, viscosity, gloss, flexibility and durability.

Acetone, also known as 2-propanone, dimethylketone and beta-ketopropane is a volatile solvent which has a boiling point of 56.5°C and is miscible with an extremely large number of solvents including water, alcohol, dimethylformamide, chloroform, methylene chloride, toluene, esters, including methylacetate and ethylacetate, benzene and toluene, ethers and numerous oils and hydrocarbons, among others. A number of prior art references disclose acetone as one of a large number of solvents which are useful for formulating nail enamels. The uniqueness of acetone for use in the present invention resides in the fact that acetone will interact with solvents used in nail enamel preparations of the present invention to produce a solvent system which evaporates in under three minutes and instills acceptable characteristics which are desired in nail enamels.

It has surprisingly been discovered that the inclusion of specific weight percentages of acetone in combination with additional solvents, preferably including wetting agents and diluents in compositions for coating natural and synthetic nails containing thixotropic agents produces a nail coating composition which dries in a period of time less than about three minutes and produces a coating on a nail which is hard, flexible and has good wear characteristics including durability and high gloss. Moreover, the use of acetone in the volatile component of nail enamel compositions of the present invention within specific weight percentages provides a consistent basis upon which one of ordinary skill in the art may modify nail enamel compositions according to the present invention without dramatically adversely affecting the drying time of the nail enamel and without dramatically adversely affecting other characteristics which are required for commercially competitive nail enamels.

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Objects of the Present Invention

It is therefore an object of the present invention to provide a pigmented nail polish composition containing an organoclay thixotropic agent which can be applied to natural and synthetic nails and will dry in a period of about 3 minutes, or less, preferably about two minutes or less, most preferably about 90 seconds or less and especially about 60 seconds or less.

It is an additional object of the present invention to provide a clear nail enamel containing an absence of pigment and organoclay thixotropic agent which can be used as a basecoat or top coat which dries in less than 30 seconds.

It is a further object of the present invention to provide a general method for making nail polish formulations, which will dry in a period less than three minutes.

It is still another object of the present invention to provide a nail preparation kit comprising a base adapted for forming a coating on a natural or synthetic nail and a suitable solvent system which together will provide a coating of nail enamel which dries in a period less than about three minutes.

It is still a further object of the present invention to provide a novel method for coating nails with a pigmented nail polish composition containing an organoclay thixotropic agent which dries in a period of about three minutes or less, preferably less than about two minutes, most preferably about 90 seconds or less and especially about 60 seconds or less.

It is yet an additional object of the present invention to provide a novel method for coating nails with a clear nail enamel which can also be used as a basecoat or top coat which dries in less than 30 seconds.

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It is yet another object of the present invention to provide a number of solvent systems which may be added to standard nail polish formulations to substantially hasten the drying of a nail enamel composition to a durable, hard finish exhibiting high gloss without adversely affecting the favorable characteristics of the complete nail polish formulation.

These and other objects of the present invention may be readily gleaned from the description of the invention which is set forth herein.

#### Brief Description of the Invention

In accordance with the objects of the present invention there is provided a nail enamel preparation comprising a fluid mixture adapted for drying and hardening to form a coating on a nail. The fluid mixture comprises, in part, a plurality of solvents, one of which is acetone, the others being a wetting agent and a diluent. In nail enamel compositions according to the present invention, acetone comprises about 4.5% to about 35% by weight. It has surprisingly been discovered that acetone will interact with a large number of solvents within a nail coating composition to produce a composition which will dry within a period of time significantly shorter than would be expected from the evaporation rates of the individual solvents. It is particularly surprising that the nail enamel compositions according to the present invention dry in such short periods of time and provide favorable viscosity and wear characteristics including gloss and durability.

The present invention therefore relates to novel compositions for coating natural and synthetic nails which dry to a hard, flexible coating exhibiting favorable characteristics of durability and high gloss comprising:

- a) a primary film-forming polymer;
- b) a secondary film-forming polymer;
- c) at least one plasticizer;
- d) at least one thixotropic agent, preferably an

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organoclay thixotropic agent;

e) at least one pigment; and

f) an amount of acetone ranging from about 4.5% to about 35% by weight of said composition in combination with at least one solvent, said solvent preferably including a wetting agent and at least one diluent solvent said solvent combination dissolving said primary and secondary film-forming polymers and said plasticizer and producing a gelled composition in combination with said thixotropic agent having a static viscosity ranging from about 400 to about 1200 centipoises. The compositions of the present invention dry on a natural or synthetic nail surface within a period of time less than about three minutes.

In addition to the components set forth above, the compositions of the present invention may further comprise additional agents, for example, fragrances and preservatives, among others.

It is a surprising result that the nail enamel compositions embraced by the present invention which include significant quantities of solvents which include acetone in the disclosed weight ranges and which have a static viscosity generally ranging from about 400 to about 1200 centipoises, preferably, approximately 800 centipoises, consistently dry in about three minutes or less. It is particularly surprising that the inclusion of certain weight percentages of acetone in combination with numerous solvents which do not otherwise dry within a period of about three minutes or less will produce nail enamel compositions which will dry in a period of time less than about three minutes, for example, about two and a half minutes, about 90 seconds or even less than about 1 minute.

In certain compositions according to the present invention which do not include thixotropic agents and pigments, an especially fast drying clear base coat or top coat formulation is presented comprising about 18% to about 35% by weight acetone, preferably about 24% to about 35% by weight

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acetone, in combination with other solvents, primary film-forming polymer, secondary film-forming polymer and at least one plasticizer. Such compositions, which can be used as base coats, top coats or clear enamels, dry in a period of time less than about 30 seconds.

It is also surprising that the solvent combinations which are used in the compositions of the present invention dry in such a short period of time in a uniform fashion without streaking or precipitation of the solid material. The resulting enamel coat is uniform, hard and flexible and exhibits favorable durability, high gloss and wear characteristics.

In accordance with the present invention, the nail enamel compositions of the present invention include an effective amount of a primary film-forming polymer to provide durability, hardness, gloss and adhesion to the nail enamel in combination with a secondary film-forming polymer after it dries on a nail or other flexible surface. The primary film-forming polymer is used as the base material for the nail enamel to give the nail enamel compositions their basic properties. In the present invention numerous film-forming polymers may be used as the primary film-forming polymer alone or in combination including cellulose acetate, cellulose acetate-butyrate, ethyl cellulose, numerous vinyl polymers as well as a number of methacrylate and acrylate type polymers. Additional primary film-forming polymers include, for example, nitro-starch and polyvinyl acetate, methacrylate and nitrocellulose, polyvinylacetate and nitrocellulose, polyurethanes, polyamides, alkyl vinyl ether-maleic anhydride copolymer, polyvinyl butyral, siloxanylalkyl ester-(meth)acrylate copolymers, polyacrylic and polyethyleneimine/polyepoxide copolymers, among others. Preferably, nitrocellulose is used as the primary film-forming polymer in the present invention.

In addition to the primary film-forming polymer, the compositions of the present invention also include an amount of a secondary film-forming polymer effective to strengthen

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the primary film-forming polymer and also provide the enamel coating with acceptable gloss and adhesion characteristics in combination with the primary film-forming polymer. Exemplary secondary film-forming polymers or resins which may be used in the present invention include, for example, drying and nondrying alkyd resin, polyvinyl resins, for example polyvinyl acetate, polyester resins, acrylate and methacrylate resins, alkyd resins, melamine resins, polyamides, ester gums, rosin and polyesters and polytetrahydrofuran and arylsulfonamide-formaldehyde resins, for example toluene sulfonamide-formaldehyde resin, among others. These secondary film-forming polymers are added to the primary film-forming polymers of the present invention to strengthen and add acceptable wear characteristics in combination with the primary film-forming polymer. Toluene sulfonamide-formaldehyde resin, a condensation product of formaldehyde and toluene sulfonamide (available from for example, Akzo Chemie America, Chicago, Illinois as Ketjenflex MS-80™), is especially preferred for use as a secondary film-forming polymer in the present invention.

In addition to the primary and secondary film-forming polymers the compositions according to the present invention also comprise at least one plasticizer, preferably for example, dibutyl phthalate and most preferably a mixture of dibutyl phthalate and camphor to add characteristics of flexibility to the nail coating. Certain secondary film-forming polymers, for example, toluene sulfonamide/epoxy resin and toluene sulfonamide/epoxy resin butyl acetate, available from Telechemische, Newburgh, New York, which have acceptable plasticization characteristics may be used in certain embodiments of the present invention without the need to include a separate plasticizer.

In addition to the above-described components, the compositions of the present invention may additionally comprise a thixotropic agent, preferably an organoclay thixotropic agent, for example, hectorite clays modified with quaternary ammonium compounds, such as the Bentones™, avail-

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able from NL Industries, New Jersey, USA as suspension agents for the nail polish and in addition a coloring substance or pigment to give the preparation a cosmetically acceptable shade and to opacify the film.

In addition to the components set forth above, the compositions of the present invention may also include further additives including stabilizers, preservatives, fragrances and anti-oxidants, among others.

To provide acceptable static viscosities within the range of about 400 to about 1200 centipoises, the nail enamel compositions of the present invention which contain an organoclay thixotropic agent generally comprise about 50% to about 75% (and in certain cases up to about 80%) by weight solvent, preferably about 60% to about 70% by weight solvent, and most preferably about 64% to about 69% by weight solvent.

In addition to the disclosed weight percentages of acetone which are used in the present invention, other exemplary solvents include for example, ethyl acetate, methyl acetate, propyl acetate, methanol, ethanol, isopropanol, n-butanol, n-butyl acetate, methylchloroform, methylene chloride, toluene, xylene, additional aromatic (containing phenyl groups) solvents and mixtures thereof, among others, including amyl acetate, numerous ethers, numerous ketones including methylethylketone and alkanes including pentane, cyclopentane, hexane, and cyclohexane, among others, in varying weight percentages. In addition to the above-named solvents, other solvents which may be used in the present invention include, for example, cyclic ethers such as tetrahydrofuran and 1,4-dioxane, among others. High boiling solvents, for example, cellosolve, butyl cellosolve acetate, cellosolve acetate, methyl cellosolve acetate, butyl cellosolve, ethyl cellosolve and phenylated solvents including xylene may also be used. Of course, these high-boiling solvents, because of their tendency to increase drying times are included in weight percentages in compositions of the present invention in amounts consistent with producing a nail composi-

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tion which dries in about three minutes or less. One of ordinary skill in the art will know to vary the weight percentages of acetone and the other solvents used in compositions of the present invention within the teachings of the present invention to produce a large number of acceptable solvent combinations for use in nail enamel compositions which dry in a period of about three minutes or less.

In certain aspects of the present invention it has been found advantageous that the solvent system used in the nail enamel compositions according to the present invention include, in addition to an effective amount of acetone to reduce the drying time of the nail enamel to below three minutes, a wetting agent and a diluent solvent. A wetting agent is included in compositions according to the present invention to provide favorable interaction with the nitrocellulose film-forming polymer and to a lesser extent, other components in the formulation.

In the present invention, it has been found advantageous to include acetone in amounts ranging from about 4.5% to about 35% (preferably above about 7% within this range), more preferably about 13% to about 30% and most preferably about 15% to about 25% by weight acetone. In certain embodiments of the present invention in which pigment and a Bentone<sup>™</sup> thixotropic agent such as Bentone RSNCT<sup>™</sup> or Bentone 27<sup>™</sup> is included, about 18% to about 22% by weight acetone has been found to be especially advantageous to produce nail enamel compositions having fast drying times.

In addition to acetone, certain aspects of the present invention also include a wetting agent such as an alcohol, for example, ethanol, isopropanol, methanol or n-butanol. The amount of wetting agent for use in the nail enamel compositions according to the present invention may range from about 0.1% to about 25% by weight, above which amount, the viscosity of the compositions may tend to fall below commercially acceptable levels. The amount of wetting agent is included in compositions according to the present invention to provide a

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favorable interaction with the primary film-forming polymer, especially nitrocellulose. Generally, however, wetting agents in amounts of less than about 10% and preferably less than about 5% by weight of the nail enamel composition are used. In most commercially available nitrocellulose, a wetting agent such as isopropanol is often included.

The compositions of the present invention also generally include at least one additional solvent other than acetone or a wetting agent, which, for purposes of defining the present invention is the diluent solvent. The diluent solvent may be any solvent which is compatible with the wetting agent and acetone and in combination with the acetone and wetting agent provides solubility characteristics which are consistent with dissolving the primary-film forming polymer, the secondary film-forming polymer and the plasticizer and with forming a gel with the thixotropic agents which are used in the present invention. In addition, diluents may be chosen to increase the viscosity of the formulations as well. Exemplary diluents for purposes of the present invention include esters, preferably an ester of acetic acid such as methyl acetate, ethyl acetate, propyl acetate, n-butyl acetate, amyl acetate, among others and mixtures of these esters especially including mixtures of ethyl acetate and n-butyl acetate in amounts ranging up to about 50% or more by weight of the nail enamel compositions, and preferably about 20% to about 30% by weight of the nail enamel compositions.

Other diluents for use in the present invention include the aromatic diluents, for example, toluene, xylene and certain naphtha derivatives. Toluene is a diluent which is used in many commercial nail enamels. Because of the regulatory implications of using certain of these diluent solvents, a number of substitutes for toluene may be included in compositions of the present invention. Substitutes for toluene include for example the previously mentioned diluent esters of acetic acid such as methyl acetate, ethyl acetate, propyl acetate, n-butyl acetate and amyl acetate and also include certain chlorinated hydrocarbons, for example,

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methylene chloride, methylchloroform, various ketones other than acetone including methylethyl ketone and various hydrocarbons including hexane, heptane, cyclohexane and pentane and certain ethers, including for example cyclic ethers such as tetrahydrofuran and 1,4-Dioxane, petroleum ether and higher boiling ethers, among others. These diluent solvents may be used to replace toluene or may be used in combination with toluene.

It is an especially surprising result that a nail enamel composition containing acetone in an amount ranging from about 4.5% to about 35% by weight of the final composition in combination with a solvent system which otherwise does not dry or evaporate within a period of about three minutes on a human or artificial nail will dry in a time period of about three minutes or less. The solvents which are included with acetone in the present invention are chosen for their ability, in combination with acetone, to dissolve the primary film-forming polymer, the secondary film-forming polymer and the plasticizer and for their ability to provide a final static viscosity in combination with the solids of the compositions of the present invention including pigment and thixotropic agent in the range of about 400 to about 1200 centipoises, preferably about 800 centipoises. In the case of compositions which include organoclay thixotropic agents, solvents are chosen for their ability to provide adequate gel formation of the thixotropic agent(s) as well as for the previously described characteristics of dissolving the solid components of the nail enamel. In basecoat/topcoat nail enamel compositions of the present invention, the viscosity ranges beyond that range disclosed for compositions containing a thixotropic agent and pigment.

The present invention also relates to a nail preparation kit comprising a polymer base adapted for drying and hardening to form a pigmented coating on a nail upon mixture of the base with a suitable solvent mixture, the solvent mixture comprising an amount of acetone comprising at least about 4.5% to about 35% by weight of the final nail enamel composition

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including solids in combination with a plurality of solvents which include acetone, a wetting agent and a diluent and which dissolve a primary film-forming polymer, a secondary film-forming polymer and a plasticizer, the composition having a final static viscosity ranging from about 400 to about 1200 centipoises, preferably about 800 centipoises. In addition to primary film-forming polymer, secondary film-forming polymer and plasticizer, the polymer base additionally comprises an organoclay thixotropic agent and at least one pigment and optionally, other additives including preservatives and fragrances, among others. In this nail preparation kit aspect of the present invention, the polymer base comprises about 25% to about 50% by weight of the final nail enamel composition to be applied to the nail and the solvents comprise about 50% to about 75% by weight of the composition, preferably about 60% to about 70% by weight and most preferably about 64% to about 68% by weight solvent.

The nail preparation kit aspect of the present invention also includes top coat, basecoat and clear nail enamel compositions which contain at least about 18% to about 35% by weight acetone, preferably at least about 24% to about 35% by weight acetone and an absence of pigment and thixotropic agent. These compositions dry in a period of time no greater than about 30 seconds and have viscosities which often range outside the range generally established for compositions containing thixotropic agent.

In still another aspect of the present invention, solvent mixtures particularly adapted for use in combination with pigmented polymer bases for use in nail enamel compositions are also disclosed. In this aspect of the present invention, a solvent mixture comprises acetone in an amount equal to about 6% to about 70% by weight of the solvent mixture and at least one wetting agent and at least one diluent solvent to produce a solvent mixture which, in combination with a polymer base containing an organoclay thixotropic agent adapted for use in pigmented nail enamel preparations, provides a gelled nail enamel preparation comprising at least about 4.5% to

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about 35% by weight acetone in combination with a wetting agent and a diluent, said nail enamel composition having a static viscosity ranging from about 400 to about 1200 centipoises and drying in a period less than three minutes to a hard, flexible pigmented surface having acceptable wear characteristics including durability and high gloss. Solvent systems for use in basecoat, top coat and clear enamel compositions containing at least about 24% by weight acetone up to about 70% by weight acetone.

In accordance with a further aspect of the present invention, the present invention includes a process for making the pigmented nail enamel compositions of the present invention. In accordance with this aspect of the present invention nail enamel compositions of the present invention are formulated by first mixing a solvent combination including an amount of acetone equal to about 6% to about 70% by weight of the solvent mixture in combination with a wetting agent and diluent solvent to produce a solvent mixture. Thereafter, a primary film-forming polymer, a secondary film-forming polymer and at least one plasticizer is added step-wise in any order in conjunction with vigorous mixing, until a viscous solution is produced. The compositions produced according to this method can be used as colorless nail polishes or alternatively, as base coat and top coat formulations in conjunction with colored nail polishes. After the above solution is produced, an organoclay thixotropic agent, for example, stearalkonium hectorite, is added to the above-described mixture in conjunction with vigorous stirring (under strong shearing force with, for example an industrial mixer such as a Hoffmeyer industrial mixer) generally for a period of at least about one hour to produce a gelled mixture. In the last step, one or more pigments are added to the above gelled mixture to produce the rapid drying nail enamel compositions according to the present invention. The final composition produced by the method according to the present invention obtains a final static viscosity ranging from about 400 to about 1200 centipoises.

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While it is possible to produce the compositions of the present invention following the general procedures of the method aspect of the present invention, it is clearly preferred that all mixing of the nail enamel compositions and especially those containing an organoclay thixotropic agent, preferably stearylalkonium hectorite, and pigment, be performed under high shear speed. Therefore, one of the aspects of the method of the present invention includes the use of vigorous stirring at high shear speed, for example using a Hoffmeyer industrial mixer for a period of time sufficient to produce a thixotropic gel after settling, generally at least about one hour and preferably at least about two hours.

#### Detailed Description of the Invention

Compositions of the present invention for coating a natural or synthetic nail comprise the following ingredients:

- a) a primary film-forming polymer;
- b) a secondary film-forming polymer;
- c) at least one plasticizer;
- d) at least one thixotropic agent;
- e) at least one pigment; and

f) an amount of acetone ranging from about 4.5% to about 35% by weight of said composition in combination with at least one solvent, said solvent preferably comprising a wetting agent and at least one diluent solvent said solvent combination dissolving said primary and secondary film-forming polymers and said plasticizer and producing a gelled composition in combination with said thixotropic agent having a static viscosity ranging from about 400 to about 1200 centipoises, said composition drying on a natural or synthetic nail within a period of less than about three minutes.

In certain embodiments, the compositions according to the present invention contain an absence of thixotropic agent and pigment and at least about 18% by weight acetone in combination with a wetting agent and a diluent solvent, preferably at least about 24% by weight acetone in such solvent combination so that the drying time is less than about 30

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seconds. These compositions may be used as clear nail enamel or alternatively as base coats or top coats for application to nails.

In addition to the above components, the compositions according to the present invention may further comprise one or more additional agents, for example, stabilizers, fragrances, anti-oxidants and preservatives, among others.

The compositions of the present invention contain a primary film-forming polymer for example, cellulose acetate, cellulose acetate-butyrate, ethyl cellulose, numerous vinyl polymers as well as a number of methacrylate and acrylate type polymers and combinations of these polymers and related film-forming polymers as described herein. The preferred primary film-former for use in the present invention is nitrocellulose.

Nitrocellulose for nail enamel compositions of the present invention is of two standard types designated respectively, RS and SS, also designated European Type E and M, respectively. Another type of nitrocellulose, AS nitrocellulose, is generally not used in nail enamels. RS nitrocellulose, available from a number of manufacturers including S.N.P.E. of Bergerac, France (as the equivalent Bergerac type) and Hercules Inc., of Philadelphia, Pennsylvania, USA, the preferred nitrocellulose for use in nail enamels, is available in a wide range of viscosities. Although a number of different nitrocellulose film-formers may be used in compositions of the present invention including RS 18-25 cp, RS 1/4 sec. and RS 5-6 sec., European Standard 33, 28 and 11, Bergerac E19, E20, E27 and E80, it is preferred that nitrocellulose RS 1/2 second, available from Hercules, be used in the compositions of the present invention. European Standard 22 and Bergerac E35 nitrocellulose may also be used in the present invention and in many aspects these nitrocellulose types may be substituted for nitrocellulose RS 1/2 second from Hercules. One of ordinary skill in the art will recognize that in formulating nail polish compositions according to the present

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invention, different viscosities of nitrocellulose may be used, depending upon the viscosity and other characteristics of the final composition desired.

In general, the primary film-forming polymer is included in compositions of the present invention in amounts effective to provide toughness, hardness, resistance to abrasion, solvent release and a film thickness, in combination with secondary film-forming polymers and plasticizers. In general, the amount and type of primary film-forming polymer is chosen so that the nail enamel, after drying on a natural or synthetic nail will have a thickness of about 2.5 mil to 6 mil, preferably about 3 mil after only one coat. While it is to be recognized that more than one coat of nail enamel may be used to coat nails according to the present invention, preferred compositions according to the present invention are compositions that provide acceptable characteristics including film thickness after one coat.

In general, the amount of primary film-forming polymer comprises about 5% to about 25% by weight of the compositions, preferably about 7.0% to about 20% by weight of the compositions and most preferably about 10% to about 18% by weight of the composition.

In addition to the primary film-forming polymer, the compositions of the present invention also include a secondary film-forming polymer which is added to the primary film-forming polymer for its ability to provide strength, gloss and adhesion. Exemplary secondary film-forming polymers which may be used in the present invention include alkyd resins, polyvinyl resins, for example, polyvinyl acetate, polyester resins, acrylic and methacrylic resins and arylsulfonamide-formaldehyde resins, among others. Toluene sulfonamide-formaldehyde resin, a condensation product of formaldehyde and toluene sulfonamide (available as Ketjenflex MS-80™ from Akzo Chemie America Chicago, Illinois) is especially preferred for use as a secondary film-forming polymer in the present invention. In general, the amount of secondary film-forming

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polymer used is that amount effective to strengthen the primary film-forming polymer and provide an effective gloss and adhesion. One of ordinary skill in the art will be able to determine the amount of secondary film-forming polymer which may be added to the compositions of the present invention to produce the desired effect without engaging in undue experimentation. However, in general, as a guideline, the amount of secondary film-forming polymer to be used in the present invention ranges from about 3.0% to about 13% by weight of the composition, preferably about 5.0% to about 10% by weight and most preferably about 5.0 to about 7.0% by weight of the composition.

In addition to primary and secondary film-forming polymers, the compositions according to the present invention also include at least one plasticizer. Plasticizers for use in the present invention are added to soften and plasticize the primary film-forming polymer. The choice of plasticizer for a nail enamel composition may vary as a function of the color, odor, effect on viscosity of the enamel, effect on the drying rate, the amount needed to meet flexibility requirements, the volatility of the plasticizer and compatability with the other components of the compositions. Plasticizers for use in the present invention include tricresyl phosphate, diamylphthalate, dioctylphthalate, diphenylphthalate, dibutoxyphthalate, dibutyl phthalate, diethyl phthalate, dibutyl tartrate, benzyl benzoate, tributyl phosphate, butyl acetyl ricinoleate, butyl glycolate, butyl stearate, triphenyl phosphate, triethyl citrate, camphor, castor oil and dibutoxy ethylphthalate, among others. Preferred plasticizers for use in the present invention include dibutyl phthalate, camphor and especially mixtures of dibutyl phthalate and camphor. In general, plasticizer is included in the compositions of the present invention in an amount sufficient to provide acceptable flexibility to nail enamel on the human or synthetic nail surface. By acceptable flexibility, we mean that the composition will evidence a substantial absence of cracking when a 6 mil film which has been dried on an aluminum strip surface for at least two hours is bent around a 0.25" mandrel

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(available from Gardner Corporation, Florida, USA). In general, the amount of plasticizer for use in the compositions of the present invention ranges from about 2.0% to about 11.0%, preferably about 2.0% to about 7.5% and most preferably about 3.0 to about 6.0% by weight. In cases where the primary film-forming polymer or secondary film-forming polymer is instilled with plasticizer-like characteristics or with an absence of these characteristics, the amount of plasticizer may vary below and above these ratios.

In addition to the primary and secondary film-forming polymers and plasticizer, the compositions according to the present invention include a solvent mixture containing acetone, and preferably a wetting agent and a diluent solvent wherein the amount of acetone ranges from about 6.0% to about 70% of the total weight of the solvent. Because the total amount of solvent ranges from about 50% to about 75% by weight of the nail enamel compositions of the present invention, acetone therefore comprises about 4.5% to about 35% by weight of the total weight of the nail enamel compositions. The amount of acetone included in the compositions is selected to create an interaction with the other solvents that are used in the compositions. It has surprisingly been found that acetone used in combination with the additional solvents of the solvent combination will result in a nail enamel composition which will dry in less than about three minutes. By "dry" we mean that the nail enamel compositions will evidence no tack with a cotton swab (Q-tip<sup>tm</sup>, available from Chesebrough-Pond's, Greenwich, Connecticut, USA) when drawn down on to a 3 mil thick layer on lineta cards (Lineta Company, Hohokus, New Jersey) at room temperature and a relative humidity of about 50 to 55%. Of course, the drying time of a nail enamel formulation will vary to a certain degree as a function of the temperature and relative humidity of the ambient atmosphere.

Solvents other than acetone which may be used in the compositions of the present invention include, for example, wetting agents such as methanol, ethanol, isopropanol and n-butanol and various diluent solvents including amyl acetate,

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n-butyl acetate, methyl acetate, ethyl acetate, propyl acetate, methyl chloroform, methylene chloride, toluene and mixtures thereof, among others, including numerous ethers and alkanes including pentane, hexane, heptane and cyclohexane and mixtures thereof among others, in varying weight percentages. In addition to the above-named solvents, other solvents may be used in the present invention include, for example, cyclopentane, 1,4-dioxane, petroleum ether and tetrahydrofuran, including mixtures thereof, among others. High boiling solvents, for example, cellosolve, butyl cellosolve acetate, cellosolve acetate, methyl cellosolve acetate, butyl cellosolve, ethyl cellosolve and phenylated solvents including xylene may also be used. Individual wetting agents and diluent solvents may be ineffective alone for dissolving the primary film-forming polymer, secondary film-forming polymer and plasticizer or for producing the proper gelling effect when formulated in combination with an organoclay thixotropic agent.

Of course, the high-boiling solvents, i.e. those solvents having a boiling point greatly in excess of 100°C, have a tendency to increase drying times in certain compositions according to the present invention and therefore are included in weight percentages in amounts consistent with instilling the desired characteristics of the high boiling solvent and producing a nail composition which dries in less than three minutes. In certain cases, the amount of high boiling solvent may be included in an amount no greater than about 5.0% and often in an amount less than about 5% by weight of the final composition. One of ordinary skill in the art will know to vary the weight percentages of acetone and the other solvents used in compositions of the present invention within the teachings of the present invention to produce a very large number of acceptable solvent combinations for use in nail enamel compositions which dry in a period of about three minutes or less.

In addition to acetone, the inclusion of methylchloroform in compositions of the present invention in certain



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cases may have a beneficial effect on the drying time. However, the effect of methylchloroform is not nearly as great as that produced by the disclosed weight percentages of acetone.

While not being limited by way of theory, it is believed that acetone is responsible for creating an interaction with the other solvents utilized in the present invention to substantially reduce the drying times of nail compositions to about three minutes or less. Such interaction may be due to the universality of solvency that acetone displays with almost any solvent. As noted, acetone is miscible with a very large number of different solvents which vary dramatically in solubility characteristics. It is quite surprising that a combination of solvents which, in combination with the non-volatile components of the present invention, normally do not dry within a period even close to three minutes, dries in a period less than about three minutes with the inclusion of the disclosed amounts of acetone. Even more surprising is the fact that the inclusion of at least about 18% by weight acetone in combination with other solvents will produce a pigmented nail enamel composition containing thixotropic agent which will dry in about 60 seconds (in certain cases, in even less time) and a clear nail enamel composition containing an absence of pigment and thixotropic agent which dries in less than 30 seconds.

The amount of acetone included within the compositions according to the present invention varies between about 4.5% and about 35%. This range represents a guideline for inclusion of acetone in compositions according to the present invention to produce a nail enamel composition which dries in about three minutes or less. The lower limit of this range represents the least amount of acetone that is generally used to produce a nail enamel composition containing a thixotropic agent and pigment which dries in less than about three minutes. The upper limit of this range represents the amount of acetone above which begins to produce an unacceptable streaking effect on the enamel during coating. In addition,

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compositions containing more than about 35% acetone tend to fall below acceptable viscosities. Compositions according to the present invention include an amount of acetone generally falling within this range, the amount of acetone to be included being determined by the desired drying time and the additional solvents which are added to produce the desired viscosity and flow characteristics.

In many of the commercial nail enamel preparations on the market, toluene, xylene or other aromatic solvent is included in varying amounts as a diluent, generally in combination with a wetting agent which tends to be isopropanol or ethanol. The use of toluene as a diluent is to provide acceptable viscosities and other characteristics. Where toluene is used, the amount of toluene may vary from less than about 1% to more than about 30% by weight of the nail enamel compositions of the present invention. In an additional aspect, the present invention also relates to quick-drying compositions which have acceptable characteristics and which exclude toluene and other aromatic solvents which may not be acceptable for inclusion in cosmetic formulations by regulatory agencies. In this aspect of the present invention, toluene or other aromatic solvent is replaced with another solvent, especially for example, a ketone-containing composition other than acetone such as methyl ethyl ketone or a related ketone, one of the esters of acetic acid such as ethyl acetate or methyl acetate, among others. In fact, through choice of solvents, it is possible to produce a nail enamel composition in which the solvent system is comprised of innocuous solvents. In addition, certain chlorinated hydrocarbons for example, methylchloroform, methylene chloride, chloroform and hydrocarbon solvents, for example, hexane, cyclohexane, cyclopentane, pentane and heptane, as well as numerous additional solvents such as ethers, among others, may be used to replace toluene and related aromatic solvents.

In compositions of the present invention which contain an absence of pigment and organoclay thixotropic agents, virtually any low boiling solvent, i.e., a solvent which has a

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boiling point less than about 90°C, may be substituted for toluene or other aromatic (containing a phenyl or substituted phenyl group) solvent provided that the primary film-forming polymer, secondary film-forming polymer and plasticizer are dissolved by the solvent combination. In compositions without thixotropic agent or pigment, numerous high boiling solvents may also be used, but care must be taken to limit the use of such solvents to low levels to avoid increasing the drying time to above acceptable limits. An acceptable drying time for compositions which contain an absence of pigment and/or thixotropic agent is less than 30 seconds at room temperature and a relative humidity of about 50-55%. In order to produce such a fast drying time, in this aspect of the present invention, these nail enamel compositions, contain at least about 18% by weight acetone and preferably at least about 24% acetone. Following the guidelines and descriptions of the present application will enable one of ordinary skill in the art to readily substitute for toluene and still maintain the drying times within acceptable limits.

In compositions of the present invention which contain a pigment and an organoclay thixotropic agent, the choice of solvents which may substitute for the toluene or other aromatic diluent is more limited than those compositions containing an absence of thixotropic agent and pigment. In these compositions, care must be taken to substitute a solvent which, in combination with acetone, and preferably, a wetting agent and a different diluent solvent, results in a solvent combination which dissolves the primary film-forming polymer, secondary film-forming polymer and plasticizer and produces a gel in combination with the organoclay thixotropic agent. Care must be taken especially when choosing the amount and type of diluent solvent(s) to be used. In certain cases, the use of very large quantities of non-polar solvents, for example, hydrocarbons such as hexane, heptane and pentane as well as other non-polar solvents, without the inclusion of sufficient amounts of more polar solvents, may affect the ability of the organoclay thixotropic agent to form a gel, preferably a colloidal gel. In addition, the inclusion of large percent-

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ages of highly polar solvents, for example, methanol, ethanol and isopropanol in certain compositions may adversely affect the ability of the thixotropic agent to form a gel, preferably a colloidal gel and compositions to maintain storage stability for any commercially viable period of time. In addition, viscosities may be adversely affected. Therefore, as a guideline and general rule for formulating compositions of the present invention, polar substitutes for toluene as the diluent solvent in this aspect of the present invention should be limited to no greater than about 25% by weight of the total weight of the composition and preferably substantially less than about 20% by weight of the composition. Obviously, the amount of polar substitute to be used as a substitute for toluene will depend upon the type of solvent used, the relative polarity of the solvent and its effect on the gel of the present invention.

Because the amount of wetting agent used in certain compositions according to the present invention may result in a negative impact on the viscosity and to a lesser extent, the drying time of the nail enamel formulations, care should be taken to minimize the use of these solvents. In addition, the amount of wetting agent may negatively impact the organoclay thixotropic agent and the gel formed by using such agents. Most preferably, and in many cases, the amount of wetting agent should be limited to less than about 5% by weight of nail enamel formulations.

Preferably, substitutes for toluene in this aspect of the present invention include esters of acetic acid, for example methyl acetate, ethyl acetate, propyl acetate and n-butyl acetate, ketones other than acetone, including methyl ethyl ketone, chlorinated hydrocarbons, for example, methylene chloride, chloroform and methylchloroform as well as other solvents of similar polarity to toluene. More and less polar diluents than those set forth above may also be used, but care should be taken to choose the amount and type of diluent(s) based upon the amount of acetone and, in certain cases, wetting agent (both of which tend to be polar solvents) to be

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included in the compositions of the present invention.

In certain compositions according to the present invention, a pigment and an organoclay thixotropic agent is also added, generally to the suspension base during formulation. Pigments are added to the compositions to provide cosmetically acceptable shades and to opacify the films. Any number of pigments may be used in the present invention including for example, red pigments, including for example, D & C red Nos. 10, 11, 12 and 13, D & C red No. 7, TOB-BON maroon (D & C red No. 34). Other pigments which may be used in compositions according to the present invention include the Lake pigments, for example, D & C yellow No. 5 Lake, D & C Red No. 2 Lake, and Ext. D & C Red No. 2 Lake. In addition to the above-named pigments, additional pigments can include cosmetic-grade or purified titanium dioxide (white), yellow and red iron oxides, iron blue, iron black, ultramarine blue, chrome oxide greens, carbon black or lampblack (generally, in minute quantities), among others. Although the amount of pigment in compositions of the present invention will vary as a function of the type of pigment and other components included in the compositions, in general, pigments are included in an amount up to about 6.0% by weight of the composition, generally from about 0.025 to about 4.0% by weight and preferably in an amount ranging from about 0.5 to about 2.5% by weight of the composition.

In addition to or in place of certain of the above-described pigments, iridescent or pearlizing pigments or agents may be included in the compositions of the present invention, for example, "pearl essence", which is a suspension of crystalline guanine ("needle type" or "plate type") in nitrocellulose and solvents as well as other pearlizing agents. These pearlizing agents may be included for their individual appearance, their effect on the appearance of other pigments and their positive effect on wear and stability, especially adherence and resistance to shock (See, for example, DuFour, French Patent No. 1,461,812). In addition to guanine, other pearlizing agents which can be used in the

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present invention include, for example, bismuth oxychloride, titanium dioxide (also classified as a white pigment) and mica, in weight ratios readily within the teachings of the prior art, and generally, about 0.025% to about 4.0% by weight of the nail enamel compositions. The amount of pearlizing additive or pigment included in the compositions according to the present invention is not expected to substantially affect the drying times, viscosities or most other characteristics of the compositions within the concept of the present invention. Of course, it will be understood that in certain compositions which include certain pigments and/or pearlizing additives, the various components used to produce nail enamel formulations including the amount of acetone and other solvents used may have to be modified to produce commercially acceptable nail enamel formulations having advantageous drying times, viscosities and wear characteristics.

When pigments are included in compositions according to the present invention, it is generally advantageous to include an organoclay thixotropic agent for enhancing the suspension of pigment in the other components of the composition. A number of organoclay thixotropic agents used in the nail enamel art may be used to produce compositions according to the present invention, including for example, bentonite, generally sodium bentonite and calcium bentonite, montmorillonite clay, which is generally a key component of bentonite, hectorites, which are trioctahedral hydrated silicate of magnesium and lithium of the montmorillonite group of clays having the general formula  $(\text{Mg}, \text{Li})_3\text{Si}_4\text{O}_{10}(\text{OH})_2$  and smectite, which are dioctahedral and trioctahedral clay minerals (montmorillonite and saponite) and their chemical varieties which are preferably modified with quaternary ammonium compounds, for example as described in Remz, Cosmetics & Toiletries, 103, 70 (December, 1988). Preferred organoclay thixotropic agents for use in the present invention include the hectorite clays modified with quaternary ammonium compounds as described above, especially including the stearyl ammonium hectorites.

Particularly preferred hectorites for use in the pres-

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ent invention include the Bentonest<sup>tm</sup>, such as Bentone<sup>27</sup> available from NL Industries, New Jersey, USA, especially the stearalkonium hectorites. An especially preferred stearalkonium hectorite thixotropic agent for use in the present invention is Bentone RSNC<sup>tm</sup>, available from Penn Color, Doylestown, Pennsylvania USA. Bentone RSNC<sup>tm</sup> is a composition containing about 25% by weight stearalkonium hectorite milled to about 5 microns in nitrocellulose and plasticizer (camphor). In particularly preferred compositions according to the present invention, a thixotropic agent is included in an amount sufficient to produce a gel, preferably a colloidal gel. In general, the organoclay thixotropic agent is included in the compositions of the present invention in amounts sufficient to produce a colloidal gel, usually from about 0.5% to about 5% by weight of the composition, preferably about 0.5% to about 2.0% and most preferably about 1% to about 1.5% by weight of the composition.

The use of a preferred thixotropic agent, stearalkoniumhectorite, and especially Bentone RSNC<sup>tm</sup> in compositions according to the present invention results in a gel which serves to suspend the pigment and maintain the pigment in suspension for extended periods of storage. The thixotropic agents which are used in the present invention are generally combined with pigment and a sufficiently polar solvent mixture containing sufficient quantities of acetone, and preferably, a wetting agent and a diluent solvent(s) in combination with primary film-forming polymer and secondary film-forming polymer and mixed under shearing force (Hoffmeyer industrial mixer generally for a period of at least one hour, preferably two hours). In this aspect of the present invention, certain highly preferred compositions according to the present invention which include a Bentone<sup>tm</sup>, especially, for example, Bentone<sup>27</sup> or Bentone RSNC<sup>tm</sup> in sufficient quantity to produce a gel are storage stable, i.e., they maintain their viscosity, consistency and pigment in suspension without the need for significant shaking even after extended periods of storage.

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It is important to note that the acetone-containing solvent mixtures chosen for use in compositions according to the present invention which contain stearalkonium hectorite should be of sufficient polarity to favorably interact with this thixotropic agent to produce a gel upon standing after being mixed under shearing force. The gel which is produced in preferred embodiments of the present invention results in a suspension of pigment which will not settle to the same extent as nail enamel compositions which do not contain such a gel suspension. The compositions of the present invention which utilize stearalkonium hectorite thixotropic agents are therefore storage stable and may be applied to the nail even after periods of long storage by a simple shaking of the container before application. In many cases there is no need to include for example, a steel ball to enable a vigorous shaking of the composition before application as is required by many of the compositions of the prior art.

In addition to the above-described components, the compositions of the present invention may also include additional additives including stabilizers, preservatives, antioxidants, fragrances, UV absorbers, levelling agents and other additives, depending upon the desired result. These components are well known in the art and may be included in amounts well within the teachings of the art.



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The nail enamel compositions of the present invention have characteristics of quick-drying, flexibility, durability, adequate viscosity and high gloss. The pigmented compositions of the present invention dry in a period of less than about three minutes. By "dry" we mean that the compositions will evidence a substantial absence of tack (absence of smudging) after a three minute drying period at room temperature and a relative humidity of about 50-55%. Compositions of the present invention are also flexible, i.e., the composition will evidence a substantial absence of cracking when a 6 mil film which has been dried on an aluminum strip surface for at least about two hours is bent around a 0.25" mandrel (available from Gardner Corporation, Florida, USA). Compositions of the present invention are also durable and do not appreciably chip or crack for a period of at least about three days of wearing on a human or synthetic nail.

The viscosities of compositions of the present invention are commercially acceptable. In general, as previously indicated, the static viscosities of the compositions of the present invention which include an organoclay thixotropic agent generally fall within the range of about 400 to about 1200 centipoises, preferably about 800 centipoises. In certain cases, the viscosities of the compositions may fall outside these ranges. For purposes of defining the present invention, static viscosities are determined on a Brookfield RVF viscometer after at least 24 hours of incubation at 25°C using a spindle #3 at 25°C and 20 RPM. In addition to static viscosities, shaken viscosities of the compositions according to the present invention are also generally commercially acceptable. Shaken viscosities differ from static viscosities and are determined in the following two ways. First, shaken viscosities are determined using a Brookfield LVF viscometer, spindle #3 at 60 RPM after the compositions are shaken for a brief period. The compositions of the present invention exhibit a shaken viscosity under these conditions generally ranging from about 200 to about 500 centipoises, with an optimum of about 400 centipoises. Additional shaken viscosities are determined at 6 RPM on a Brookfield LVF vis-

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cometer, spindle #3 at 25°C. Viscosities of the compositions of the present invention under these conditions generally range from about 800 to about 1200 centipoises, with an optimum of about 1000 centipoises.

Compositions of the present invention generally exhibit an acceptable gloss ranging from about 70 to about 95% reflection of light as determined by a Glossguard Meter (6 mil thick coating on an aluminum surface). Preferably, the compositions of the present invention exhibit a gloss ranging from about 85 to about 95% reflection of light as determined by a Glossguard Meter.

The present invention also relates to a nail preparation kit comprising a polymer base containing an organoclay thixotropic agent adapted for drying and hardening to form a pigmented coating on a nail upon mixture of the base with a suitable solvent mixture, the solvent mixture comprising an amount of acetone comprising at least about 4.5% to about 35% by weight of the final nail enamel composition including solids in combination with a wetting agent and a solvent diluent to produce solvent combinations which dissolve the primary film-forming polymer, the secondary film-forming polymer and the plasticizer and gel the organoclay thixotropic agent, the composition having a final static viscosity ranging from about 400 to about 1200 centipoises, preferably about 800 centipoises. In addition to primary film-forming polymer, secondary film-forming polymer, plasticizer and thixotropic agent, the polymer base additionally comprises at least one pigment and optionally, additional additives including preservatives and fragrances, among others. In this nail preparation kit aspect of the present invention, the polymer base comprises about 25% to about 50% by weight of the final nail enamel composition to be applied to the nail and the solvents comprise about 50% to about 75% by weight of the composition, preferably about 60% to about 70% by weight and most preferably about 64% to about 69% by weight solvent. The nail preparation kit aspect of the present invention also includes top coat, basecoat and clear nail enamel compositions which

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contain at least about 18% to about 35% by weight acetone, preferably at least about 24% to about 35% by weight acetone in combination with a primary film-forming polymer, a secondary film-forming polymer, a plasticizer and an absence of pigment and thixotropic agent. These compositions dry in a period of time no greater than about 30 seconds.

To use the nail preparation kit of the present invention, the user will add the solvent mixture to the base formula which contains primary film-forming polymer, secondary film-forming polymer and plasticizer. After thoroughly mixing the solvent with the three solid ingredients, the resulting mixture may be used as a clear basecoat, top coat, or nail enamel. Alternatively, if a pigmented nail enamel composition is desired, after thorough mixing of the solvent, primary film-forming polymer, secondary film-forming polymer and plasticizer, an organoclay thixotropic agent is added and the mixture vigorously shaken or otherwise mixed (generally under shearing forces) for a period of time sufficient to produce a homogeneous mixture. Thereafter, pigment is introduced into the mixture and the pigment-containing mixture is thoroughly mixed until a homogeneous mixture is realized. The final product may then be stored or coated onto a natural or synthetic nail surface.

In still another aspect of the present invention, solvent mixtures particularly adapted for use in combination with pigmented polymer bases for use in nail enamel compositions are also disclosed. In this aspect of the present invention, a solvent mixture comprises acetone in an amount equal to about 6% to about 70% by weight of the solvent mixture, and preferably a wetting agent and a diluent solvent to produce a solvent mixture which, in combination with a polymer base adapted for use in nail enamel preparations comprising a primary film-forming polymer, a secondary film-forming polymer, at least one plasticizer, an organoclay thixotropic agent and pigment, provides a gelled nail enamel preparation containing at least about 4.5% to about 35% by weight acetone and which has a static viscosity ranging from about 400 to about 1200 .

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centipoises and drying in a period less than about three minutes to a hard, flexible pigmented surface having acceptable wear characteristics including durability and high gloss. Solvent systems for use in basecoat, top coat and clear enamel compositions without pigment and organoclay thixotropic agents contain at least about 24% by weight acetone up to about 70% by weight acetone.

The present invention also relates to methods of making and using the compositions of the present invention. In this aspect of the present invention nail enamel compositions of the present invention are formulated by first mixing a number of solvents including an amount of acetone equal to about 6% to about 70% by weight of the solvent mixture to produce a solvent mixture. Thereafter, a primary film-forming polymer, a secondary film-forming polymer and at least one plasticizer is added step-wise in any order in conjunction with vigorous mixing until a viscous solution is produced. The compositions produced according to this method can be used as colorless nail polishes or alternatively, as base coat and top coat formulations in conjunction with colored nail polishes. After the viscous solution is produced, an organoclay thixotropic agent, for example, stearylaluminum hectorite, is added to the above-described mixture in conjunction with vigorous stirring (under strong shearing force with a Hoffmeyer industrial mixer) generally for a period of about at least one hour to produce a gelled mixture. In the last step, one or more pigments are added to the above gelled mixture to produce the rapid drying mixtures according to the present invention. The final composition produced by the method according to the present invention obtains a final static viscosity ranging from about 400 to about 1200 centipoises. Certain compositions of the present invention produced in this way including Bentone RSN<sup>CTM</sup> and/or Bentone<sup>27</sup> are storage stable and do not require the vigorous shaking that the prior art compositions often require after extended periods of storage. The compositions of the present invention are used by simply applying the composition to the surface of a natural or synthetic nail.

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The following examples are provided to illustrate the present invention and should not be construed to limit the scope of the invention of the present application in any way.

**EXAMPLE 1**

To demonstrate the effectiveness of the solvent compositions of the present invention in speeding the rate of drying of nail enamels, a commercially available red nail enamel sold under the trademark L'OREAL "Drumbeat" was obtained and the solvents distilled therefrom. The solvents were replaced by a solvent system containing 28.28 percent acetone in combination with additional solvents, including methylchloroform, ethyl acetate, toluene, butyl acetate and isopropanol in the following weight ratios:

<u>Solvent</u>	<u>Weight Percent of Solvent in Solvent System (By Weight of Solvent)</u>	<u>Weight Percent of Solvent in Composition Based on Solids Weight Percent of 37.5%</u>
Acetone	28.28%	17.68%
Isopropanol	2.02%	1.26%
Ethyl Acetate	39.94%	24.96%
Toluene	28.81%	18.01%
Butyl Acetate	0.74	0.46%
Methyl Chloroform	0.21	0.13%

Results: The L'Oreal product "drumbeat" was evaporated to near dryness and the solvent system including 17.68% by weight acetone was added to the solids remaining after evaporation. The resulting suspension was shaken vigorously until a homogeneous suspension was realized. The viscosity was slightly thin, too thin to be commercialized. The drying time of the nail polish formulation was 70 seconds on plate glass. In comparison, the drying time of the L'Oreal product was greater than 4 minutes.

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## Examples 2-10

In the following examples, a number of solvent combinations containing about 4.5% to about 35% by weight of acetone were used to produce a number of nail enamel compositions using a standard base formulation. In each case, the drying time of the formulations are about 3 minutes or less at about room temperature and a relative humidity of 50-55%.

## Non-Volatile Component (Solids)

<u>Component</u>	<u>Weight Percent of Final Composition</u>
Primary Film-Forming Polymer Nitrocellulose RS 1/2 Sec. (From Hercules, Inc.)	10.5%
Secondary Film-Forming Polymer Toluenesulfonamide formaldehyde Resin (Ketjenflex MS-80™ From Akzo Chemie)	9.0
Plasticizer Camphor	0.4%
Dibutylphthalate	4.1%
Bentone RSNCTM Stearalkonium hectorite (25.5%) Nitrocellulose (60.5%) Camphor (14%)	12.0%

Procedure: To produce nail enamel compositions, the components listed above were added step-wise, in the order 1) primary film-forming polymer; 2) secondary film-forming polymer and 3) plasticizer to the below-described solvent systems. Each component was added and mixed until a homogeneous solution was produced. After the first three components were added, the Bentone RSNCTM was added and the resulting mixture was mixed under high shearing force with a laboratory mixer for at least about 1 hour until a homogeneous gel was obtained. Pigments are added with further mixing. The resulting compositions were then "drawn down" on lineta cards to determine drying times. Drying times were determined by placing a cotton swab (Q-tips from Cheseborough Ponds, USA) on the surface. An absence of sticking of cotton swabs to the

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film was considered dry for purposes of the present invention. The drying times of the individual experiments are presented as indicated.

All formulations evidenced acceptable viscosities and an absence of streaking. To determine static viscosities, compositions were allowed to stand for at least 24 hours in a constant temperature bath at 25°C. Static viscosity tests were performed using a Brookfield LVF, spindle #3 at 12 RPM and 25°C. To determine static viscosity the dial reading was multiplied by a factor to determine approximate viscosity (e.g.,  $8 \times 100 = 800$  cps). It should be noted that the static viscosities were determined in the following experiments with a Brookfield LVF, spindle #3, but are defined in the general invention using a Brookfield RVF, spindle #3 as those of ordinary skill in the art would define them. Because access to a Brookfield RVF was not available, the static viscosities in the following invention are presented using the available Brookfield LVF instrumentation. The compositions of the present invention have acceptable viscosities.

Shaken viscosities were determined on a Brookfield LVF using Spindle #3 at 25°C

a) at 60 RPM. To determine viscosity dial reading was multiplied by a factor to determine approximate viscosity (e.g.,  $20 \times 20 = 400$  cps).

b) at 6 RPM. To determine viscosity dial reading was multiplied by a factor to determine approximate viscosity (e.g.,  $5 \times 200 = 1000$  cps).

Because of the nature of the viscosity determination, and the fact that these determinations may depend upon the amount of shaking done (variable), shaken viscosities are believed to be less reliable than are the static viscosities.

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Example 2  
Solvent System #1

<u>Solvent</u>	<u>Percent By Weight of Final Composition</u>
Acetone	18.1%
Isopropanol	1.28
Ethyl Acetate	25.54%
N-Butyl Acetate	0.64
Methylchloroform	18.44

Results: Composition including solids was formulated as described above using 64% by weight of solvent system #1 and 36% by weight of Non-Volatile Component as described above. Drying time on lineta cards (3 mm draw down) at an ambient temperature of 68.4°F (20.2°C) and a relative humidity of about 40% was 51 seconds. Drying time in a relative humidity of about 50-55% is less than 90 seconds. Static viscosity of the formulation was 1201 cps. Shaken viscosity at 60 RPM was 504 cps and at 6 RPM was 600 cps. Pigments are added without significantly affecting drying time.

Example 3  
Solvent System #2

<u>Solvent</u>	<u>Percent By Weight of Final Composition</u>
Isopropanol	1.28
Ethyl Acetate	25.54%
N-Butyl Acetate	18.75%
Methylchloroform	18.44

Results: Absence of acetone to determine effect of acetone on drying times. Composition including solids were formulated as described above using 64% by weight of solvent system #2 and 36% by weight of Non-Volatile Component as described above. Drying time on lineta cards (3 mm draw down) at an ambient temperature of 68.4°F (20.2°C) and a relative humidity of about 40% was 3 minutes and 17 seconds. Drying time in a relative humidity of about 50-55% is about 4.0 to 5.0 minutes. Static viscosity of the formulation was 970 cps. Shaken vis-



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cosity at 60 RPM was 626 cps and at 6 RPM was 720 cps. Pigments are added without significantly affecting drying time.

Example 4  
Solvent System #3

<u>Solvent</u>	<u>Percent By Weight of Final Composition</u>
Isopropanol	1.28
Ethyl Acetate	43.96%
N-Butyl Acetate	18.75%

Results: Absence of acetone and methylchloroform to determine effect of acetone and methylchloroform on drying times. Composition including solids were formulated as described above using 64% by weight of solvent system #3 and 36% by weight of Non-Volatile Component as described above. Drying time on lineta cards (3 mm draw down) at an ambient temperature of 68.4°F (20.2°C) and a relative humidity of about 40% was 3 minutes and 9 seconds. Drying time in a relative humidity of about 50-55% is about 4 to 5 minutes. Static viscosity of the formulation was 1950. Shaken viscosity at 60 RPM was 700 cps and at 6 RPM was 740 cps.

Example 5  
Solvent System #4

<u>Solvent</u>	<u>Percent By Weight of Final Composition</u>
Acetone	18.11%
Isopropanol	1.28
Ethyl Acetate	25.54%
N-Butyl Acetate	0.51%
Methylchloroform	0.13%
Methylene Chloride	18.43%

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Results: Experiment to replace toluene with methylene chloride. Composition including solids were formulated as described above using 64% by weight of solvent system #4 and 36% by weight of Non-Volatile Component as described above. Viscosities were in acceptable range. Drying time on lineta cards (3 mm draw down) at an ambient temperature of 70°F (21.5°C) and a relative humidity of about 50% was 64 seconds. Static viscosity of the formulation was about 1650 cps. Shaken viscosity at 60 RPM was 936 cps and at 6 RPM was 2000 cps. Pigments are added as desired without significantly affecting drying time.

Example 6  
Solvent System #5

<u>Solvent</u>	<u>Percent By Weight of Final Composition</u>
Acetone	18.11%
Isopropanol	1.28
Ethyl Acetate	25.54%
N-Butyl Acetate	0.51%
Methylchloroform	0.13%
Methylethyl ketone	18.43%

Results: Experiment to replace toluene with methylethyl ketone. Composition including solids were formulated as described above using 64% by weight of solvent system #5 and 36% by weight of Non-Volatile Component as described above. Drying time on lineta cards (3 mm draw down) at an ambient temperature of 70°F (21.5°C) and a relative humidity of about 50% was 79 seconds. Static viscosity of the formulation was 1470 cps. Shaken viscosity at 60 RPM was 624 cps and at 6 RPM was 1120 cps. Pigments are added as desired.

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Example 7  
Solvent System #6

<u>Solvent</u>	<u>Percent By Weight of Final Composition</u>
Acetone	18.11%
Isopropanol	1.28
Ethyl Acetate	25.54%
N-Butyl Acetate	0.51%
Methylchloroform	0.13%
Hexane	18.43%

Results: Experiment to replace toluene with hexane. Composition including solids were formulated as described above using 64% by weight of solvent system #6 and 36% by weight of Non-Volatile Component as described above. Drying time on lineta cards (3 mm draw down) at an ambient temperature of 70°F (21.5°C) and a relative humidity of about 50% was 77 seconds. Static viscosity of the formulation was 930 cps. Shaken viscosity at 60 RPM was 710 cps and at 6 RPM was 300 cps. Pigments are added as desired without significantly affecting drying time.

Example 8  
Solvent System #7

<u>Solvent</u>	<u>Percent By Weight of Final Composition</u>
Acetone	18.11%
Isopropanol	1.28
Ethyl Acetate	25.54%
N-Butyl Acetate	0.51%
Methylchloroform	0.13%
Cyclohexane	18.43%

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Results: Experiment to replace toluene with cyclohexane. Composition including solids were formulated as described above using 64% by weight of solvent system #7 and 36% by weight of Non-Volatile Component as described above. Drying time on lineta cards (3 mm draw down) at an ambient temperature of 70°F (21.5°C) and a relative humidity of about 50% was 79 seconds. Static viscosity of the formulation was 1120 cps. Shaken viscosity was 704 cps at 60 RPM and 400 cps at 6 RPM. Pigments are added as desired. Inclusion of pigment does not significantly affect drying time.

Example 9  
Solvent System #8

<u>Solvent</u>	<u>Percent By Weight of Final Composition</u>
Acetone	4.5%
Isopropanol	1.6
Ethyl Acetate	33.16%
Toluene	23.95%
N-Butyl Acetate	0.66%
Methylchloroform	0.13%

Results: Experiment to determine effect of reduced acetone. Composition including solids were formulated as described above using 64% by weight of solvent system #8 and 36% by weight of Non-Volatile Component as described above. Drying time on lineta cards (3 mm draw down) at an ambient temperature of 72.0°F (23.0°C) and a relative humidity of about 24% was 2 minutes. Drying time in a relative humidity of about 50-55% is about 3 minutes. Pigments are added as desired without appreciably affecting the drying time.

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Example 10  
Solvent System #9

<u>Solvent</u>	<u>Percent By Weight of Final Composition</u>
Isopropanol	1.3
Ethyl Acetate	25.5%
Toluene	18.4%
N-Butyl Acetate	0.5%
Methylchloroform	0.1%
Methylene chloride	18.2

Results: Experiment to determine effect of replacement of acetone with a solvent, methylene chloride, that has a much lower boiling point than acetone. Experiment was performed to determine if interaction of lower boiling solvents with other solvents in mixture was responsible for fast drying times. Composition including solids was formulated as described above using 64% by weight of solvent system #9 and 36% by weight of Non-Volatile Component as described above. Drying time on lineta cards (3 mm draw down) at an ambient temperature of 64°F (17.8°C) and a relative humidity of about 37% was 3 minutes and 21 seconds. Drying time in a relative humidity of about 50-55% is about 4.0 to 5.0 minutes.

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Example 11  
Solvent System #10

<u>Solvent</u>	<u>Percent By Weight of</u> <u>Final Composition</u>
Acetone	18.2
Isopropanol	1.3
Ethyl Acetate	25.5%
Toluene	18.4%
N-Butyl Acetate	0.5%
Methylchloroform	0.1%

Results: Composition including solids are formulated as described above using 64% by weight of solvent system #10 and 36% by weight of Non-Volatile Component as described above. Drying time on lineta cards (3 mm draw down) at an ambient temperature of 72.7°F (23.3°C) and a relative humidity of about 55% is less than 60 seconds. Pigments are added as desired. Addition of pigment does not significantly affect the drying time.

Example 12  
Solvent System #11

<u>Solvent</u>	<u>Percent By Weight of</u> <u>Final Composition</u>
Acetone	15.0
Isopropanol	1.3
Ethyl Acetate	25.5%
Toluene	21.7%
N-Butyl Acetate	0.5%

Results: Composition including solids was formulated as described above using 64% by weight of solvent system #10 and 36% by weight of Non-Volatile Component as described above. Drying time on lineta cards (3 mm draw down) at an ambient temperature of 68°F (21.7°C) and a relative humidity of about

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40% was about 1 minute 44 seconds. Pigments are added as desired. Addition of pigment does not significantly affect the drying time. Static viscosities were between 700 and 800 centipoises. Shaken viscosities were between 600 and 900 centipoises.

Example 13  
Solvent System #12

<u>Solvent</u>	<u>Percent By Weight of Final Composition</u>
Acetone	35.0
Isopropanol	0 (In Nitrocellulose)
Ethyl Acetate	13.3%
Toluene	10.0%
N-Butyl Acetate	0.5%
<u>Non-volatile</u>	<u>Percent By Weight of Final Composition</u>
Nitrocellulose 1/2 Sec. (Hercules, Inc.)	21.0
Toluene Sulfonamide Resin (MS-80™)	9.0
Camphor	2.1
Dibutyl phthalate	4.1
Bentone 27™	5.0

Results: Composition including solids was formulated as described above using 64% by weight of solvent system #12 and 36% by weight of Non-Volatile Component as described above. Drying time on lineta cards (3 mm draw down) at an ambient temperature of 68°F (21.7°C) and a relative humidity of about 40% is about 1 minute 16 seconds. Addition of pigment does not significantly affect the drying time. Granular surface texture, but useable. Static viscosities were between 900 and 1500 centipoises. Shaken viscosities were between 700 and 1200 centipoises. High concentration of Bentone 27™ (5.0%) could be reduced substantially to provide lower viscosities. Pigments are added without substantially affecting drying times or other characteristics of product.

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**Example 14**  
Nail Polish Formulation

In this example, a number of components are first prepared for later combination into a finished formula. First, the following two solvent blends were prepared:

<u>Solvent</u>		<u>Solvent Blend A</u>		<u>Percent By Weight of Blend</u>	
Acetone				28.3%	
Isopropyl Alcohol				2.0%	
Ethyl Acetate				39.9%	
Toluene				28.8%	
N-butyl acetate				1.0%	

Solvent Blend B

<u>Solvent</u>		<u>Percent By Weight of Blend</u>	
Ethyl acetate		44.0%	
N-butyl acetate		13.0%	
Toluene		43.0%	

From the above-listed solvent blends A and B, a color solution and Bentone-containing suspending paste were prepared from the following components:

Color Solution C

<u>Component</u>		<u>Percent By Weight of Blend</u>	
D & C Red #7 color Chip		10.0%	
Titanium Dioxide Chip		5.0%	
Solvent Blend A		85.0%	

The color chips (available from Penn Color, Inc., Doylestown, Pennsylvania) and solvent blend were combined and mixed at high speed with a laboratory cowles dissolver for approximately ten minutes. A smooth, particle free solution resulted.

A pigment suspending paste was prepared from the following components:

Pigment Suspending Paste D

<u>Component</u>		<u>Percent By Weight of Blend</u>	
Bentone <sup>27</sup>		10.0%	
Solvent Blend B		90.0%	

The above two components were combined and blended using very high shearing explosion proof Waring<sup>TM</sup> Blender for

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five minutes resulting in a smooth, high viscosity paste.

A nitrocellulose-containing solution was prepared from the following components:

#### Nitrocellulose Solution E

<u>Component</u>	<u>Percent By Weight of Blend</u>
Nitrocellulose 1/2 Second R.S. from Hercules, Philadelphia, PA.	35%
Solvent Blend A	65%

The above components were combined using the laboratory cowles dissolver as the mixing device. A smooth uniform, clear lacquer was obtained from the above mixture.

A sample of red Fast Drying nail enamel was prepared from the above-described components as follows:

<u>Component</u>	<u>Percent By Weight of Enamel</u>
Nitrocellulose Solution E	51.45%
Bentone <sup>27</sup> Paste D	10.0%
Camphor	3.09%
Dibutyl Phthalate	6.77%
Color Solution C	15.00%
Toluene Sulfonamide Resin	5.20%
Acetone	8.49%

The above components were combined using the laboratory cowles dissolver as the mixing device to produce a sample of Red Fast Drying nail enamel acceptable as a commercial preparation.

The red Fast Drying nail enamel contains the following components:

<u>Component</u>	<u>Percent By Weight of Enamel</u>
Nitrocellulose 1/2 second R.S. (Hercules)	17.87%
Isopropyl Alcohol	0.925%
Acetone	21.58%
N-butyl acetate	1.63%
Toluene	17.18%
Ethyl acetate	22.41%
Bentone <sup>27</sup>	1.0%
Camphor	3.09%
Dibutyl Phthalate	6.77%
D. & C. Red 7 Chip	1.50%
(35% Pigment, 17% DiButylphthalate, 48% Nitrocellulose)	
Titanium Dioxide Chip	0.75%

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(71% Pigment, 7% Camphor,  
22% Nitrocellulose)  
Toluene Sulfonamide Resin 5.20%

The above formula yielded a very attractive red nail enamel with good gloss. It has a very fast drying time of about two minutes or less utilizing the previously described method for determining drying time. A panel was conducted and 10 panelists were chosen to wear the formula. They found the above quick drying nail enamel to be a very satisfactory product with an exceptionally fast drying time relative to commercially available products.

Example 15  
Composition Containing 15% by Weight Acetone

Following the methodology used for producing the composition in examples 1-13, a nail enamel composition containing the final weight percentages of the example 14 components was produced. In the following example, the acetone of 21.58% by weight was reduced to about 15% by weight making up the loss with toluene (the highest boiling solvent in the mixture). The pigmented chips from Example 12 were replaced with nitrocellulose 1/2 Sec. (Hercules, Inc., Philadelphia, Pa.) and Bentone RSNCTM.

<u>Solvent Component</u>	<u>Percent By Weight</u>
Acetone	15.0%
Isopropyl Alcohol (IPA)	0.9%
n-Butyl Acetate	1.6%
Ethyl Acetate	22.4
Toluene	23.8%

  

<u>Non-Volatile Component</u>	<u>Percent By Weight</u>
Nitrocellulose 1/2 Sec. (Hercules, Inc.)	19.15
Bentone 27 <sup>TM</sup>	0.75
Bentone RSNCTM (Contains Camphor and Nitrocellulose)	1.00
Camphor	3.20
Dibutyl Phthallate	7.00
Toluene Sulfonamide	5.20
Formaldehyde Resin (Ketjenflex MS-80 <sup>TM</sup> )	

The above formula yielded static viscosities of 300-

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400 centipoises. It had a drying time of 2 minutes 36 seconds at 68 degrees and approximately 40% relative humidity using the previously described method for determining drying time. Pigments are added to produce attractive nail enamels having favorable characteristics.

Example 16  
Base Coat/Top Coat Composition

<u>Component</u>	<u>Percent By Weight</u>
Nitrocellulose RS 1/2 Sec. (Hercules, Inc.)	8.2
Toluene Sulfonamide Formaldehyde (Ketjenflex MS-80™)	3.5
Camphor	1.50
Dibutyl Phthallate	2.0
Acetone	18.0
Isopropyl Alcohol	3.8
Ethyl Acetate	57.0
n-Butyl acetate	1.4
Toluene	4.6

The above formula is made by the method described for Examples 2-13, above by adding the non-volatile components step-wise to the solvent mixture. The formula has a very fast drying time of less than about 30 seconds at room temperature and a relative humidity of 50-55% using the previously described method for determining drying time. This formula makes an acceptable base coat/top coat formulation for use alone or with pigmented formulations including those described in the present invention.

Example 17  
Base Coat/Top Coat Composition

<u>Component</u>	<u>Percent By Weight</u>
Nitrocellulose RS 1/2 Sec. (Hercules, Inc.)	8.2
Toluene Sulfonamide Formaldehyde (Ketjenflex MS-80™)	3.5
Camphor	1.50
Dibutyl Phthallate	2.0
Acetone	24.0
Isopropyl Alcohol	3.8
Ethyl Acetate	51.0
n-Butyl acetate	1.4
Toluene	4.6

The above formula is made by the method described for

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Examples 2-13, above by adding the non-volatile components step-wise to the solvent mixture. The formula has a very fast drying time of less than 30 seconds at room temperature and a relative humidity of 50-55% using the previously described method for determining drying time. This formula makes an acceptable base coat/top coat formulation for use alone or with pigmented formulations including those described in the present invention.

Example 18  
Base Coat/Top Coat Composition

<u>Component</u>	<u>Percent By Weight</u>
Nitrocellulose RS 1/2 Sec. (Hercules, Inc.)	8.2
Toluene Sulfonamide Formaldehyde (Ketjenflex MS-80 <sup>TM</sup> )	3.5
Campher	1.50
Dibutyl Phthallate	2.0
Acetone	35.0
Isopropyl Alcohol	3.8
Ethyl Acetate	40.0
n-Butyl acetate	1.4
Toluene	4.6

The above formula is made by the method described for Examples 2-13, above by adding the non-volatile components step-wise to the solvent mixture. The formula has a very fast drying time of less than 30 seconds at room temperature and a relative humidity of 50-55% using the previously described method for determining drying time. This formula makes an acceptable base coat/top coat formulation for use alone or with pigmented formulations including those described in the present invention.

This invention has been described in terms of specific embodiments set forth in detail herein, but it should be understood that these are by way of illustration and the invention is not necessarily limited thereto. Modifications and variations will be apparent from the disclosure and may be resorted to without departing from the spirit of the inventions those of skill in the art will readily understand. Accordingly, such variations and modifications are considered

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to be within the purview and scope of the invention and the following claims.

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## CLAIMS

1. A quick-dry nail enamel composition for coating natural and synthetic nails of animals and humans comprising:
  - a) a primary film-forming polymer;
  - b) a secondary film-forming polymer;
  - c) at least one plasticizer;
  - d) an amount of at least one organoclay thixotropic agent effective to produce gelling of said composition;
  - e) at least one pigment; and
  - f) an amount of acetone ranging from about 4.5% to about 35% by weight of said composition in combination with at least one additional solvent said solvent combination dissolving said primary and secondary film-forming polymers and said plasticizer and producing a gelled composition in combination with said organoclay thixotropic agent having a static viscosity ranging from about 400 to about 1200 centipoises, said composition drying within about three minutes or less to a durable, flexible coating exhibiting a substantial absence of tack.
2. The composition according to claims 1 or 2 wherein said primary film-forming polymer is nitrocellulose.
3. The composition according to claim 2 wherein said secondary film-forming polymer is toluene sulfonamide-formaldehyde resin.
4. The composition according to claims 1-3 wherein said organoclay thixotropic agent is stearylalkonium hectorite.
5. The composition according to claims 1-4 wherein said solvent includes a diluent solvent.
6. The composition according to claim 5 wherein said diluent solvent is selected from the group consisting of ethyl acetate, methyl acetate, propylacetate, n-butylacetate, amylacetate, toluene and mixtures thereof.
7. The composition according to claim 5 wherein said diluent solvent is selected from the group consisting of ethyl acetate, propylacetate, methyl acetate, n-butylacetate, amylacetate, methylchloroform, methylene chloride, methylethylketone, toluene, xylene, amyl acetate, pentane, hexane, heptane, cyclopentane and cyclohexane, 1,4-dioxane, tetrahydrofuran, petroleum ether and mixtures thereof.

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8. The composition according to claims 1-7 wherein said solvent includes a wetting agent selected from the group consisting of ethanol, isopropanol and n-butanol in an amount ranging from about 0.1% to about 10% by weight.

9. The composition according to claims 1-8 wherein said plasticizer is selected from the group consisting of dibutylphthalate, camphor and mixtures thereof.

10. The composition according to claim 1-9 wherein said pigment is a pearllizing agent or includes a pearllizing agent.

11. The composition according to claims 1-10 wherein said acetone is included in an amount ranging from about 13% to about 35% by weight of said composition.

12. The composition according to claim 1-11 wherein said acetone is included in an amount ranging from about 15% to about 35% by weight of said composition.

13. The composition according to claims 5-12 wherein said organoclay thixotropic agent is stearalkonium hectorite.

14. The composition according to claim 1 wherein said primary film-forming polymer is nitrocellulose, said secondary film-forming polymer is toluene sulfonamide-formaldehyde resin, said plasticizer is a mixture of dibutylphthalate and camphor, said solvent includes isopropanol as a wetting agent and a diluent solvent comprising at least two solvents selected from the group consisting of ethyl acetate, propylacetate, methyl acetate, n-butylacetate, amylacetate, methylchloroform, methylene chloride, methylethylketone, toluene, xylene, amyl acetate, pentane, hexane, heptane, cyclopentane, cyclohexane, 1,4-dioxane, tetrahydrofuran and petroleum ether.

15. The composition according to claim 14 wherein said diluent solvent comprises at least one ester selected from the group consisting of ethyl acetate, propylacetate, n-butyl acetate, methylacetate, amyl acetate and mixtures thereof in an amount ranging from about 20% to about 30% by weight of said composition.

16. The composition according to claim 1 wherein said elements a, b, c, d and e comprise about 30% to about 40% by weight of said composition.

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17. A quick-dry nail enamel composition for coating natural and synthetic nails of animals and humans comprising:

a) an amount of a primary film-forming polymer ranging from about 5% to about 25% by weight;

b) an amount of a secondary film-forming polymer ranging from about 3.0% to about 13% by weight;

c) an amount of at least one plasticizer ranging from about 2.0% to about 11.0% by weight;

d) an amount of at least one organoclay thixotropic agent effective to produce gelling of said composition;

e) at least one pigment; and

f) an amount of acetone ranging from about 15% to about 35% by weight of said composition in combination with a wetting agent and a diluent solvent said solvent combination dissolving said primary and secondary film-forming polymers and said plasticizer and producing a gelled composition in combination with said organoclay thixotropic agent having a static viscosity ranging from about 400 to about 1200 centipoises, said composition drying on a natural or synthetic nail to a durable, flexible coating exhibiting a substantial absence of tack.

18. The composition according to claim 17 wherein said primary film-forming polymer is nitrocellulose.

19. The composition according to claims 17 or 18 wherein said secondary film-forming polymer is toluene sulfonamide-formaldehyde resin.

20. The composition according to claims 17-19 wherein said organoclay thixotropic agent is stearylalkonium hectorite.

21. The composition according to claims 17-20 wherein said wetting agent is selected from the group consisting of ethanol, isopropanol and n-butanol in an amount ranging from about 0.1% to about 10% by weight.

22. The composition according to claims 17-21 wherein said diluent solvent is selected from the group consisting of esters of acetic acid, toluene and mixtures thereof.

23. The composition according to claims 17-22 wherein said diluent solvent is ethyl acetate, methyl acetate, propyl acetate, n-butylacetate, amylacetate and mixtures thereof.

24. The composition according to claims 17-21 wherein



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said diluent solvent is selected from the group consisting of ethyl acetate, methyl acetate, propylacetate, n-butylacetate, amylacetate, methylchloroform, methylene chloride, methylethylketone, toluene, xylene, amyl acetate, pentane, hexane, heptane, cyclopentane and cyclohexane, 1,4-dioxane, tetrahydrofuran, petroleum ether and mixtures thereof.

25. The composition according to claims 17-24 wherein said plasticizer is selected from the group consisting of dibutylphthalate, camphor and mixtures thereof.

26. The composition according to claims 17-25 wherein said pigment is a pearlizing agent or includes a pearlizing agent.

27. The composition according to claim 26 wherein said pearlizing agent is guanine.

28. The composition according to claim 17-27 wherein said acetone is included in an amount of at least about 18% by weight of said composition.

29. The composition according to claim 17 wherein said primary film-forming polymer is nitrocellulose, said secondary film-forming polymer is toluene sulfonamide-formaldehyde resin, said plasticizer is a mixture of dibutylphthalate and camphor, said wetting agent is isopropanol and said diluent solvent is a mixture containing at least two solvents selected from the group consisting of ethyl acetate, methyl acetate, n-butylacetate, amylacetate, methylchloroform, methylene chloride, methylethylketone, toluene, xylene, pentane, hexane, heptane, cyclopentane, cyclohexane, 1,4-dioxane, tetrahydrofuran and petroleum ether.

30. The composition according to claim 28 wherein said diluent solvent comprises at least one ester selected from the group consisting of ethyl acetate, propyl acetate, n-butyl acetate, methylacetate, amyl acetate and mixtures thereof in an amount ranging from about 20% to about 30% by weight of said composition and at least one additional solvent selected from the group consisting of toluene and xylene.

31. The composition according to claims 17-30 wherein said elements a, b, c, d and e comprise about 30% to about 40% by weight of said composition.

32. A quick-dry composition for coating natural and

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synthetic nails of animals and humans comprising:

a) an amount of nitrocellulose as a primary film-forming polymer ranging from about 5% to about 25% by weight of said composition;

b) an amount of toluene-sulfonamide formaldehyde resin as a secondary film-forming polymer ranging from about 3% to about 13% by weight of said composition;

c) an amount of at least one plasticizer selected from the group consisting of dibutyl phthalate, camphor and mixtures thereof in an amount ranging from about 2.0% to about 11% by weight of said composition;

d) an amount of an organoclay thixotropic agent effective to produce gelling of said composition;

e) at least one pigment in an amount ranging from about 0.025 to about 4% by weight of said composition; and

f) a solvent combination comprising an amount of acetone ranging from about 4.5% to about 35% by weight of said composition in combination with at least one alcohol selected from the group consisting of ethanol, isopropanol and n-butanol and at least one ester selected from the group consisting of methyl acetate, ethyl acetate, propyl acetate, n-butyl acetate and amyl acetate, said solvent combination dissolving said primary film-forming polymer and said secondary film-forming polymer and producing a gelled composition in combination with said organoclay thixotropic agent having a static viscosity ranging from about 400 to about 1200 centipoises, said composition drying within a period of about three minutes or less to a durable, flexible coating.

33. The composition according to claim 32 wherein said organoclay thixotropic agent is stearylalkonium hectorite included in an amount ranging from about 0.5% to about 5.0% by weight.

34. The composition according to claim 32 or 33 wherein said solvent combination further includes toluene.

35. The composition according to claims 32-34 wherein said alcohol is isopropanol.

36. The composition according to claims 32-35 wherein said ester includes ethyl acetate and n-butyl acetate.

37. The composition according to claims 32-36 wherein

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said pigment is a pearlizing agent or includes a pearlizing agent.

38. The composition according to claim 37 wherein said pearlizing agent is guanine.

39. A method of coating a natural or synthetic nail with a nail enamel composition comprising applying to a natural or synthetic nail a nail enamel composition comprising:

- a) a primary film-forming polymer;
- b) a secondary film-forming polymer;
- c) at least one plasticizer;
- d) at least one thixotropic agent;
- e) at least one pigment; and
- f) an amount of acetone ranging from about 4.5% to about 35% by weight of said composition in combination with at least one additional solvent having sufficient polarity in combination with said acetone to dissolve said primary and secondary film-forming polymers and said plasticizer to produce a stable composition having a static viscosity ranging from about 400 to about 1200 centipoises, said composition drying on a natural or synthetic nail within a period of less than about three minutes to a hard, flexible coating exhibiting favorable characteristics of durability and high gloss.

40. The method according to claim 39 wherein said primary film-forming polymer is nitrocellulose.

41. The method according to claim 39 or 40 wherein said secondary film-forming polymer is toluene sulfonamide-formaldehyde resin.

42. The method according to claims 39-41 wherein said thixotropic agent is stearylalkonium hectorite, and said additional solvent in combination with said acetone is of sufficient polarity to favorably interact with said thixotropic agent to provide a gel suspension.

43. The method according to claims 39-42 wherein said plasticizer is selected from the group consisting of dibutylphthalate, camphor and mixtures thereof.

44. The method according to claims 39-43 wherein said plasticizer is a mixture comprising dibutylphthalate and camphor.

45. The method according to claims 39-44 wherein said

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additional solvent is selected from the group consisting of ethyl acetate, methyl acetate, propyl acetate, methanol, ethanol, isopropanol, n-butanol, n-butylacetate, methylchloroform, methylene chloride, methylethylketone, toluene, xylene, aromatic solvents, amyl acetate, hydrocarbons including pentane, hexane, cyclopentane and cyclohexane, 1,4-dioxane, tetrahydrofuran and mixtures thereof.

46. The method according to claims 39-45 wherein said additional solvent is a mixture containing at least two solvents selected from the group consisting of ethyl acetate, methyl acetate, ethanol, isopropanol, toluene, n-butylacetate, methylchloroform, methylene chloride, hexane, cyclohexane and methylethylketone.

47. The method according to claims 39-46 wherein said acetone is included in an amount ranging from about 13% to about 35% by weight of said composition, said composition drying in a period of time of less than about two minutes.

48. The method according to claims 39-47 wherein said acetone is included in an amount ranging from about 18% to about 35% by weight of said composition.

49. The method according to claims 39-48 wherein said thixotropic agent is stearalkonium hectorite, and said additional solvent in combination with said acetone is of sufficient polarity to favorably interact with said thixotropic agent to provide a gel suspension.

50. The method according to claim 39 wherein said primary film-forming polymer is nitrocellulose, said secondary film-forming polymer is toluene sulfonamide-formaldehyde resin, said plasticizer is a mixture of dibutylphthalate and camphor, said additional solvent is a mixture containing at least two solvents selected from the group consisting of ethyl acetate, methyl acetate, ethanol, isopropanol, toluene, n-butylacetate, methylchloroform, methylene chloride, hexane, cyclohexane and methylethylketone.

SUBSTITUTE SHEET

# INTERNATIONAL SEARCH REPORT

International Application No. PCT/US 90/07267

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (In several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC(5): A61K 7/04 U.S. Cl.: 424/61		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched *		
Classification System	Classification Symbols	
U.S.	424/61	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched *		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT *</b>		
Category *	Citation of Document, ** with indication, where appropriate, of the relevant passages †	Relevant to Claim No. ‡
X	US, A, 4,421,881 (BENKENDORF) 20 DECEMBER 1983; See column 2, lines 37-54, column 3, lines 46-55, column 4, lines 23-50 and column 8, lines 15-30.	1,14-19, 29, 32-34, 39-41
Y	US, A, 4,425,326 (GUILLOU) 10 JANUARY 1984; See column 4, lines 53-62, columns 5, lines 20-24 column 7, lines 20-65 and column 8, lines 20-66.	1,14-19, 32-34, 39-41
Y	US, A, 4,798,720 (HOLDER) 17 JANUARY 1989; See column 2, lines 51-66 and column 3, lines 5-53.	1,14-19, 29, 32-34, 39-41
<p>* Special categories of cited documents: †</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"A" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report:	
28 March 1991	02 MAY 1991	
International Searching Authority †	Signature of Authorized Officer ‡	
ISA/US	D. Gabrielle Phelan	

## FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V ☒ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE <sup>1</sup>

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers ..... because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claim numbers ..... because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
- 2-13, 20-28 30, 31, 35-38 and 42-49
3. ☒ Claim numbers ..... because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(s).

VI ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING <sup>2</sup>

This international Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claim:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the international Searching Authority did not invite payment of any additional fee.

Remark on Protest:

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.